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[Title of the Invention] LIQUID CRYSTAL DISPLAY DEVICE

[Abstract]

[Object] To suppress gap unevenness and display unevenness generated when keeping at a high-temperature if projections are formed on a substrate in order to make the gap of a liquid crystal layer uniform.

[Solving Means] On the glass substrate 1, a color filter layer 2 and a light shield layer 3 are formed for each pixel and an over coat layer 4 and a transparent display electrode 5 are entirely thereupon. Then a projection 6 is formed of resin at the formation position of the light shield layer 3. Then spherical spacers 14 which are a little larger than the projection length are arranged between projections 6 at constant intervals. Then liquid crystal is charged and sealed with a sealing material 12 while the upper and lower substrates are applied with depression pressure. Thus, the spacers 14 are made to elastically deform. Even when the liquid crystal display device is held in a high-temperature state, the gap between the upper and lower substrates increases, but no gap unevenness is caused.

[Claims]

[Claim 1] A liquid crystal display device in which a circumference of a first and second glass substrates having

a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprising:

a projection formed in a plurality of places on either one of the first and second glass substrates and having the same height as a target gap; and

spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a height of the projection, and disposed in some places between the projections,

wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[Claim 2] A liquid crystal display device in which a circumference of a first and second glass substrates having a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprising:

a light shield layer formed in a pixel unit in a plurality of places of a transparent substrate constituting the first glass substrate and shielding a boundary area of each pixel;

a projection provided in an upper portion of the light

shield layer formed in the first glass substrate and having the same height as a target gap; and

spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a height of the projection, and disposed in some places between the projections,

wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[Claim 3] A liquid crystal display device in which a circumference of a first and second glass substrates having a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprising:

a light shield layer formed in a pixel unit in a plurality of places of a transparent substrate constituting the first glass substrate and shielding a boundary area of each pixel;

a projection provided in an upper portion of the light shield layer by a specific space of the light shield layers formed in the first glass substrate and having the same height as a target gap; and

spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a

height of the projection, and disposed in some places between the projections,

wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[Claim 4] A liquid crystal display device according to any one of claims 1 to 3, wherein a color filter layer having the light shield layer is formed in a display pixel unit on the transparent substrate.

[Claim 5] A liquid crystal display device according to any one of claims 1 to 4, wherein the spacers are sustained in the state elastically deformed to have the approximately same size as the projection.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a liquid crystal display which uses in an OA appliance such as an image display appliance, a personal computer or a word processor, a handy terminal device of industry field, and a portable information communication appliance, etc.

[0002]

[Description of the Related Art]

A liquid crystal display device falls behind in a

screen size and the pixel number, compared to a CRT, but it has an advantage in a weight or a volume and is often used in a product field requiring the portability. A liquid crystal display device having a size of 10 to 12 inch and used in a notebook computer or a word processor has a pixel of 640×480 dot or 600×800 dot. This falls behind in the pixel number, compared to a CRT, but can be used as an excellent display device.

[0003]

However, a liquid crystal display device using a simple matrix represented in STN (super twisted nematic) requires a uniform display together with a wide screen or high precision. The uniform display id determined by uniform orientation as a mark of a method of arranging a liquid crystal molecule and a uniform gap between substrates clamping liquid crystals. Specifically, in a wide screen or a high precision liquid crystal display device, it is hard to obtain a uniform gap in a display surface when manufacturing. A method of controlling the uniformity of a gap is exemplified by a method of controlling a gap between substrates within a predetermined value using spacers. However, recently, as disclosed in Japanese Unexamined Patent Application Publication No. H9-120075, a method of controlling a gap by forming a projection on one side of the substrate without using the spacers is suggested.

[0004]

A conventional liquid crystal display using a projection will be described with reference to Figs. 5 and 6. Fig. 5 is a cross-sectional view illustrating a structure of a conventional liquid crystal display device. Fig. 6 is a cross-sectional view illustrating a state when a conventional liquid crystal display device is placed at the high temperature. As shown in Fig. 5, a color filter layer 2 consisting of 3 colors of red, green, and blue is formed on a glass substrate 1 and a light shield layer 3 having a lattice shape is formed between each color. An over coat layer 4 consisting of transparent resins is formed, a transparent display electrode 5 consisting of an ITO film is provided, and a first substrate is manufactured. In an upper portion of the transparent display electrode 5, a projection 6 consisting of resins is formed at the same position as a forming position of the light shield layer 3. An orientation film 8 consisting of polyimide, etc. is formed in the order on the transparent display electrode 5 between the projections 6. On the other hand, the transparent display electrode 10 is formed on substrates 9 opposite to each other and a second substrate is manufactured.

The orientation films 11 are stacked. Next, the circumference of the first and second substrates is sealed

by sealants 12 and a fixed gap between substrates is secured by the projections 6. Liquid crystals are filled up within the gap and a liquid crystal layer 13 is formed.

[0005]

[Problems to be Solved by the Invention]

However, in a case where a liquid crystal display device is manufactured by using the projection 6 for controlling a gap, when the liquid crystal display device is maintained or used under high temperature, as described in Fig. 6, the liquid crystal layer 13 is expanded. Due to this, a gap between the substrates under high temperature is larger than that at the room temperature. At this time, because the projection 6 formed on the substrate is little moved by heating, there is no member to support between the substrates. As a result, the partial difference in a gap between the substrates is generated. At this time, as a display state of the liquid crystal display device, display unevenness is observed in the screen due to an uneven gap.

[0006]

In order to realize a request of the market such as wide screen, high precision, and high speed, when the function of the display is further enhanced, in a conventional panel construction, the display unevenness is generated at temperature change and specifically at high temperature and thus it is hard to obtain a good display

grade.

[0007]

The present invention is to solve the above-mentioned problem, and an object of the present invention is to provide a liquid crystal display device capable of uniformly keeping a display grade by not allowing a gap between substrates to be uneven even if a using temperature changes in a liquid crystal display device which has a wide screen or a high precision display.

[0008]

[Means for Solving the Problems]

[Embodiments]

In order to solve the above-mentioned problem, according to claim 1 of the present invention, in a liquid crystal display device in which a circumference of a first and second glass substrates having a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprises a projection formed in a plurality of places on either one of the first and second glass substrates and having the same height as a target gap; and spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a height of the projection, and disposed in some places between the

projections, wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[0009]

According to claim 2 of the present invention, in a liquid crystal display device in which a circumference of a first and second glass substrates having a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprises a light shield layer formed in a pixel unit in a plurality of places of a transparent substrate constituting the first glass substrate and shielding a boundary area of each pixel; a projection provided in an upper portion of the light shield layer formed in the first glass substrate and having the same height as a target gap; and spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a height of the projection, and disposed in some places between the projections, wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[0010]

According to claim 3 of the present invention, in a

liquid crystal display device in which a circumference of a first and second glass substrates having a display electrode with respect to a transparent substrate is sealed with a seal material and liquid crystals are filled in a gap between the first and second glass substrates, the liquid crystal display device comprises a light shield layer formed in a pixel unit in a plurality of places of a transparent substrate constituting the first glass substrate and shielding a boundary area of each pixel; a projection provided in an upper portion of the light shield layer by a specific space of the light shield layers formed in the first glass substrate and having the same height as a target gap; and spacers formed in a spherical shape using a material softer than the projection, whose diameter is larger than a height of the projection, and disposed in some places between the projections, wherein the first and second glass substrates are fixed to each other by applying a pressure so that the spacers are elastically deformed.

[0011]

According to claim 4 of the present invention, in a liquid crystal display device according to any one of claims 1 to 3, a color filter layer having the light shield layer is formed in a display pixel unit on the transparent substrate.

[0012]

According to claim 5 of the present invention, in a liquid crystal display device according to any one of claims 1 to 4, the spacers are sustained in the state elastically deformed to have the approximately same size as the projection.

[0013]

[Description of the Embodiments]

(A first embodiment)

A liquid crystal display in according to the first embodiment of the present invention will be described with reference to Figs. 1 and 2. Fig. 1 is a cross-sectional view illustrating a structure of a liquid crystal display device according to a first embodiment of the present invention and the same elements as a conventional technique are denoted by like reference numerals and thus the detailed description will be omitted. As shown in Fig. 1, a color filter layer 2 made of 3 colors of red, green, and blue is formed on a glass substrate 1 that is a transparent substrate. A light shield layer 3 is formed at a position between each color. Further, an over coat layer 4 that is a transparent resin is formed on the light shield layer 3 and a transparent display electrode 5 consisting of ITO is formed on a entire surface of the substrate and thus the first substrate is manufactured. In an upper portion of the transparent display electrode 5, a projection 6 consisting

of a resin is formed in the same position as a forming position of the light shield layer 3. As a projection material, a transparent photosensitive resin (for example, JNPC43 made by JSR) is used, a height of the projection is, for example, 6μm, and one projection 6 is formed for one RGB. An orientation film material is coated on an upper portion of the transparent display electrode 5 and the orientation film 8 is formed on a portion excluding the projection 6.

[0014]

A transparent display electrode 10 is formed even in an opposing substrate 9 and the second substrate is manufactured. The orientation film 11 is stacked on the second substrate. Next, spherical spacers 14 are scattered between the first and second substrates. The spacer uses a material softer than the projection 6 and has a sphere shape. The spacer is made of, for example, GSZ made by Japan catalyst, the particle diameter thereof is somewhat larger than the projection 6 and is, for example, 6.1μm, and the scattering number thereof is 10 to 20 piece/㎟. Finally, the circumference of the substrate is sealed by a sealant 12 and the liquid crystal layer 13 is formed by filling up liquid crystals. At this time, a gap is controlled by applying a pressure to the substrate so that a final cell gap becomes 6.0μm. As shown in Fig. 1, at this state, a shape of the spacer 14 is deformed by 0.1μm from a sphere

and becomes a rotational ellipsoid. Thus, the first and second substrates are supported and a liquid crystal display device is manufactured.

[0015]

The liquid crystal display device thus manufactured is lighted up at the normal temperature and a uniform display is confirmed through confirmation of the display grade. Further, when the display state is confirmed after the manufactured liquid crystal display device is sustained during 1 hour under the high temperature of 40□, the display unevenness caused by an uneven gap between the substrates is not showed and it is not showed at the half-tone display. Fig. 2 is a cross-sectional view illustrating a state when a liquid crystal display device according to the first embodiment is placed at the high temperature. As shown in the figure, if the liquid crystal layer 13 is expanded by the rise of the temperature, a bottom surface of the substrate 9, that is, the bottom surface of the orientation film 11 is separated from the front of the projection 6. However, a gap between the glass substrate 1 and the substrate 9 is uniformly sustained by the spherical spacer 14 and thus the display unevenness is not generated.

[0016]

(A second embodiment)

A liquid crystal display in according to the second

embodiment of the present invention will be described with reference to Figs. 3 and 4. Fig. 3 is a cross-sectional view illustrating a structure of a liquid crystal display device according to a second embodiment of the present invention and the same elements as the first embodiment are denoted by like reference numerals and thus the detailed description will be omitted. As shown in the figure, a color filter layer 2 made of 3 colors of red, green, and blue is formed on a glass substrate 1 that is a transparent substrate. A light shield layer 3 is formed at a position between each color. Further, an over coat layer 4 that is a transparent resin is formed on the light shield layer 3 and the color filter layer 2 and a transparent display electrode 5 consisting of ITO is formed on a entire surface of the substrate and thus the first substrate is manufactured.

[0017]

Next, in an upper portion of the transparent display electrode 5, a projection 6 consisting of a resin is formed in the same position as a forming position of the light shield layer 3. Unlike the first embodiment, the projection is formed on one light shield layers 3 instead of three light shield layers. As a projection material, a transparent photosensitive resin (for example, JNPC43 made by JSR) is used, a height of the projection is, for example, 6μm, and one projection 6 is formed for one RGB. Next, an

orientation film material is coated on an upper portion of the transparent display electrode 5 where the projection 6 is formed and the island-shaped orientation film 8 is formed.

[0018]

A transparent display electrode 10 is formed even in an opposing substrate 9 and the second substrate is manufactured. The orientation film 11 is stacked on the second substrate. Next, spherical spacers 14 are scattered between the first and second substrates. The spacer 14 uses a material softer than the projection 6 and has a sphere shape. The spacer is made of, for example, GSZ made by Japan catalyst, the particle diameter thereof is somewhat larger than the projection 6 and is, for example, 6.1μm, and the scattering number thereof is 10 to 20 piece/㎟. As shown in Fig. 3, the scattering place is the upper portion of the light shield layer 3 where the projection 6 is not formed. Finally, the circumference of the first and second substrates is sealed by a sealant 12 and the liquid crystal layer 13 is formed by filling up liquid crystals. At this time, a pressure to apply to the two substrates is controlled so that a final cell gap becomes 6.0μm, whereby at a state where the spacer 14 is deformed by 0.1μm, the substrates are supported.

[0019]

The liquid crystal display device thus manufactured is

lighted up at the normal temperature and a uniform display is confirmed through confirmation of the display grade. Further, when the display state is confirmed after the manufactured liquid crystal display device is sustained during 1 hour under the high temperature of 40℃, the display unevenness caused by an uneven gap between the substrates is not showed and it is not showed at the half-tone display.

[0020]

Fig. 4 is a cross-sectional view illustrating a state when a liquid crystal display device according to the second embodiment is placed at the high temperature. As shown in the figure, if the liquid crystal layer 13 is expanded by the rise of the temperature, a bottom surface of the substrate 9, that is, the bottom surface of the orientation film 11 is separated from the front of the projection 6. However, a gap between the glass substrate 1 and the substrate 9 is uniformly sustained by the expanded or recovered spherical spacer 14 and thus the display unevenness is not generated.

[0021]

[Advantages]

As described above, according to the present invention, in a liquid crystal display device in which the projection is formed on the substrate to control a gap between the

substrates, by clamping the spacer having a diameter larger than a height of the projection to have the almost same size as a height of the projection, although even the liquid crystal layer is expanded as the liquid crystal display device sustains a relatively high temperature, it is possible to suppress an uneven gap between the substrates from generating by a restoration force of the spacer. Therefore, although the temperature in the using environment rises, it is possible to obtain a uniform display. Specifically, as the liquid crystal display device has wide screen and high precision, the effects have an advantage.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a cross-sectional view illustrating a structure of a liquid crystal display device according to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a cross-sectional view illustrating a state when a liquid crystal display device according to the first embodiment is placed at the high temperature.

[Fig. 3]

Fig. 3 is a cross-sectional view illustrating a structure of a liquid crystal display device according to a second embodiment of the present invention.

[Fig. 4]

Fig. 4 is a cross-sectional view illustrating a state when a liquid crystal display device according to the second embodiment is placed at the high temperature.

[Fig. 5]

Fig. 5 is a cross-sectional view illustrating a structure of a conventional liquid crystal display device.

[Fig. 6]

Fig. 6 is a cross-sectional view illustrating a state when a conventional liquid crystal display device is placed at the high temperature.

[Reference Numerals]

1: glass substrate
2: color filter layer
3: light shield layer
4: over coat layer
5: transparent display electrode
6: projection
8, 11: orientation film
9: substrate
10: transparent display electrode
12: seal material
13: liquid crystal layer
14: spacer